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One of the attractive features of isogeometric analysis is the exact representation of the geometry. The geometry is furthermore given by a relative low number of control points and this makes isogeometric analysis an ideal basis for shape optimisation. I will describe some of the results we have obtained and also some of the problems we have encountered.

One of these problems is that the geometry of the shape is given by the boundary alone. And, it is the parametrisation of the boundary which is changed by the optimisation procedure. But isogeometric analysis requires a parametrisation of the whole domain. So in every optimisation cycle we need to extend a parametrisation of the boundary of a domain to the whole domain. It has to be fast in order not to slow the optimisation down but it also has to be robust and give a parametrisation of high quality. These are conflicting requirements so we propose the following approach. During the optimisation a fast linear method is used, but if the parametrisation becomes singular or close to singular then the optimisation is stopped and the parametrisation is improved using a nonlinear method. The optimisation then continues using a linear method.

We will explain how the validity of a parametrisation can be checked and we will describe various ways to parametrise a domain. We will in particular study the Winslow functional which turns out to have some desirable properties.

Other problems we touch upon is clustering of boundary control points (design variables) and self intersection of the design. The first problem can be solves by a suitable regularisation and the latter by a method that resembles how the validity of the parametrisation is secured.

References

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